

What is claimed is:

1. A hydraulic turbine distributor comprising:

a stay ring;

a flow mouth located inside of the stay ring;

a plurality of wicket gates mounted to the flow mouth and having outer edge portions moveable adjacent the stay ring to define sweep areas adjacent the stay ring; and,

at least one first fish friendly projection extending outwardly of the stay ring adjacent the sweep areas and acting as a first barrier preventing fish from being trapped between the wicket gates and the stay ring.

2. The hydraulic turbine distributor of claim 1 wherein:

the stay ring has upper and lower stay ring portions and a plurality of annularly spaced apart stay vanes each extending between the upper and lower stay ring portions;

the flow mouth has upper and lower lips positioned inwardly of the upper and lower stay ring portions, and each of the upper and lower lips is respectively vertically offset inwardly from corresponding portions of the upper and lower stay ring portions;

the plurality of wicket gates are rotatably mounted between the upper and lower lips, and the wicket gates are moveable between open and closed positions respectively permitting and inhibiting liquid flow through the distributor and to define the sweep areas adjacent the upper and lower stay ring portions of the stay ring; and,

the at least one first fish friendly projection comprises a first corresponding fish friendly projection for each of the wicket gates extending from the lower stay ring portion and acting as first barriers preventing fish from being trapped between the wicket gates and the lower stay ring portion, the first fish friendly projection having a first sill portion projecting outwardly of the lower lip and at least coextensive with, and adjacent to, at least one of the sweep areas, and the at least one fish friendly projection having a first apron

portion extending from the first sill portion to the lower stay ring portion.

3. The hydraulic turbine of claim 2 wherein the first sill portion projects outwardly of the lower lip at the same horizontal level as the lower lip.

4. The hydraulic turbine distributor of claim 2 wherein the apron portion slopes providing a first ramp effect between the lower lip and the first sill portion.

5. The hydraulic turbine distributor of claim 2 wherein the first corresponding fish friendly projection is built by a weld formed on the lower stay ring portion.

6. The hydraulic turbine distributor of claim 2 wherein the first apron portion partially surrounds the sweep area and, in plan view, has a generally rounded V-shape whose apex is located outwardly of the distributor.

7. The hydraulic turbine distributor of claim 2 wherein each of the wicket gates has an inner edge portion and a lower gate portion extending from the outer edge portion to the inner edge portion, and wherein the inner edge portion has a concavely recessed portion adjacent the lower gate portion whereby the concavely recessed portion of the inner edge portion does not extend beyond the lower lip and into the turbine when the wicket gate is in its open position so as to reduce shear forces adjacent thereto.

8. The hydraulic turbine distributor of claim 7 wherein each of the wicket gates has an upper gate portion extending between the inner and outer edge portions, each of the wicket gates pivoting about trunions that extend vertically within the distributor and the outer edge portion sloping forward from the upper gate portion to the lower gate portion and outwardly of the distributor from the upper gate portion to the lower gate portion.

9. The hydraulic turbine of claim 2 further comprising a second corresponding fish friendly projection for each of the wicket gates extending from the upper stay ring portion and acting as second barriers preventing fish from being trapped between the wicket gates and the upper stay ring portion, the second fish friendly projection having a second sill portion projecting outwardly of the upper lip and at least coextensive with, and adjacent to, at

least one of the sweep areas, and the second fish friendly projection having a second apron portion extending from the second sill portion to the upper stay ring portion.

10. The hydraulic turbine of claim 9 wherein the first sill portion projects outwardly of the lower lip at the same horizontal level as the lower lip and wherein the second sill portion projects outwardly of the upper lip at the same horizontal level as the upper lip.

11. The hydraulic turbine distributor of claim 9 wherein the first apron portion slopes providing a first ramp effect between the lower lip and the first sill portion and wherein the second apron portion slopes providing a second ramp effect between the upper lip and the second sill portion.

12. The hydraulic turbine distributor of claim 9 wherein the first corresponding fish friendly projection is built by a first weld formed on the lower stay ring portion and the second corresponding fish friendly projection is built by a second weld formed on the upper stay ring portion.

13. The hydraulic turbine distributor of claim 9 wherein the first apron portion partially surrounds the sweep area and, in plan view, has a generally rounded V-shape whose apex is located outwardly of the distributor.

14. The hydraulic turbine distributor of claim 9 wherein each of the wicket gates has an inner edge portion and a lower gate portion extending from the outer edge portion to the inner edge portion, and wherein the inner edge portion has a concavely recessed portion adjacent the lower gate portion whereby the concavely recessed portion of the inner edge portion does not extend beyond the lower lip and into the turbine when the wicket gate is in its open position so as to reduce shear forces adjacent thereto.

15. The hydraulic turbine distributor of claim 14 wherein each of the wicket gates has an upper gate portion extending between the inner and outer edge portions, each of the wicket gates pivoting about trunions that extend vertically within the distributor and the outer edge portion sloping forward from the upper gate portion to the lower gate portion and outwardly of the distributor from the upper gate portion to the lower gate portion.

16. The hydraulic turbine of claim 1 wherein:

the stay ring has upper and lower stay ring portions and a plurality of annularly spaced apart stay vanes each extending between the upper and lower stay ring portions;

the flow mouth has upper and lower lips positioned inwardly of the upper and lower stay ring portions, and each of the upper and lower lips is respectively vertically offset inwardly from corresponding portion of the upper and lower stay ring portions;

the plurality of wicket gates are rotatably mounted between the upper and lower lips, and the wicket gates are moveable between open and closed positions respectively permitting and inhibiting liquid flow through the distributor and to define the sweep areas adjacent the upper and lower stay ring portions of the stay ring; and,

the at least one first fish friendly projection extends from the lower stay ring portion, and the fish friendly projection has a first sill portion projecting outwardly of the lower lip and at least coextensive with, and adjacent to, at least one of the sweep areas, and a first apron portion extending from the first sill portion to the lower stay ring portion.

17. The hydraulic turbine of claim 16 wherein the first sill portion projects outwardly of the lower lip at the same horizontal level as the lower lip.

18. The hydraulic turbine distributor of claim 16 wherein the apron portion slopes providing a first ramp effect between the lower lip and the first sill portion.

19. The hydraulic turbine distributor of claim 16 wherein the at least one first fish friendly projection is built by a weld formed on the lower stay ring portion.

20. The hydraulic turbine distributor of claim 16 wherein each of the wicket gates has an inner edge portion and a lower gate portion extending from the outer edge portion to the inner edge portion, and wherein the inner edge portion has a concavely recessed portion adjacent the lower gate portion whereby the concavely recessed portion of the inner edge portion

does not extend beyond the lower lip and into the turbine when the wicket gate is in its open position so as to reduce shear forces adjacent thereto.

21. The hydraulic turbine distributor of claim 20 wherein each of the wicket gates has a upper gate portion extending between the inner and outer edge portions, each of the wicket gates pivoting about trunions that extend vertically within the distributor and the outer edge portion sloping forward from the upper gate portion to the lower gate portion and outwardly of the distributor from the upper gate portion to the lower gate portion.

22. The hydraulic turbine of claim 16 further comprising at least one second fish friendly projection extending from the upper stay ring portion and acting as a second barrier preventing fish from being trapped between at least one of the wicket gates and the upper stay ring portion, the at least one second fish friendly projection having a second sill portion projecting outwardly of the upper lip and at least coextensive with, and adjacent to, at least one of the sweep areas, and the at least one second fish friendly projection having a second apron portion extending from the second sill portion to the upper stay ring portion.

23. The hydraulic turbine of claim 16 wherein the first sill portion projects outwardly of the lower lip at the same horizontal level as the lower lip and wherein the second sill portion projects outwardly of the upper lip at the same horizontal level as the upper lip.

24. The hydraulic turbine distributor of claim 16 wherein the first apron portion slopes providing a first ramp effect between the lower lip and the first sill portion and wherein the second apron portion slopes providing a second ramp effect between the upper lip and the second sill portion.

25. The hydraulic turbine distributor of claim 16 wherein the at least one first fish friendly projection is built by a first weld formed on the lower stay ring portion and the at least one second fish friendly projection is built by a second weld formed on the upper stay ring portion.

26. The hydraulic turbine distributor of claim 16 wherein each of the wicket gates has an inner edge portion and a lower gate portion extending

from the outer edge portion to the inner edge portion, and wherein the inner edge portion has a concavely recessed portion adjacent the lower gate portion whereby the concavely recessed portion of the inner edge portion does not extend beyond the lower lip and into the turbine when the wicket gate is in its open position so as to reduce shear forces adjacent thereto.

27. The hydraulic turbine distributor of claim 26 wherein each of the wicket gates has a upper gate portion extending between the inner and outer edge portions, each of the wicket gates pivoting about trunions that extend vertically within the distributor and the outer edge portion sloping forward from the upper gate portion to the lower gate portion and outwardly of the distributor from the upper gate portion to the lower gate portion.